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minor axis is situated within the range of $0.5 \pm 1/6$ in the thickness direction of the mask body, from one of surface sides of the effective area, where L is the length from the minor axis of the effective area to a major-axis-direction end thereof, and

said joint portion of each of the electron beam passage apertures in a region at the distance of $2L/3$ or more in the major-axis direction from the minor axis of the effective area is situated outside the range of $0.5 \pm 1/6$ in the thickness direction of the mask body.

REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1, 3-4, and 6 are pending in the application, with Claim 2 and 5 having been cancelled and Claims 1, 3-4, and 6 having been amended by way of the present amendment.

In the outstanding Official Action, Claim 2 was objected to and Claims 1-6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Lerner (U.S. Patent No. 3,707,640) in view of Simpson et al. (U.S. Patent No. 5,730,887).

Claims 2 and 5 are hereby cancelled and the features of Claims 2 and 5 have been incorporated into independent Claims 1 and 4, respectively. Claims 1, 3, and 6 are further amended to more clearly describe Applicants' claimed invention. Support for these amendments is found in Applicants original disclosure.¹ No new matter is added.

Regarding the objection to Claim 2, Applicants note that the features of Claim 2 have incorporated into Claim 1 have been slightly modified to overcome the pending objection. That is, Claim 1 (as well as Claim 4 now recite "the joint body ...is within a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from one surface side of the effective area

¹ Specification, page 15, line 25 – page 21, line 22.

when the thickness of the mask body is represented by 1.” Applicants therefore submit the objection has been overcome.

Briefly recapitulating, amended Claim 1 is directed to a shadow mask comprising a mask body including a substantially rectangular effective area having a minor axis and a major axis extending at right angles to each other. The mask body also includes a large number of electron beam passage apertures formed in the effective area. Each of the electron beam passage apertures are formed of a communication hole connecting a larger hole opening in one surface of the effective area and a smaller hole opening in the other surface of the effective area. In a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of at least the electron beam passage apertures in the central portion of the effective area is situated in a central portion in the thickness-direction of the mask body. The joint portion is within a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from one surface side of the effective area, when the thickness of the mask body is represented by 1. In a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of the electron beam passage apertures located on the major axis and in the peripheral portion of the effective area is situated closer to one of the surface sides of the effective area than the joint portion of each of the electron beam passages apertures in the central portion of the effective area, the larger hole being offset against the smaller hole in the direction of the major axis. Claim 4 is directed to a cathode ray tube comprising the shadow mask of Claim 1.

Electron beam passage apertures formed according to the above-mentioned structure permit the extent of etching of the mask body to be minimized thereby permitting an increase in the volume of the mask body. This increase of the mask body volume can translate to an increase in mask body thickness, thereby improving mask strength. Further, with the above-mentioned structure, the balance in mechanical strength between the central and peripheral

portions of the mask body can be improved. Thus, it is possible to provide a color cathode ray tube in which deformation and vibration of the shadow mask is reduced, thereby improving image quality level.²

Lerner discloses a shadow mask with larger and smaller aperture holes in a cross section of a mask body.³ As noted in the Official Action, Lerner does not disclose “the larger hole being offset against the smaller hole in the direction of the major axis” as recited in independent Claims 1 and 4. Applicants submit that, Lerner (USP 3,707,640) also does not teach a specific location for the joint portion between the Lerner small-diameter portion 11a and the Lerner large-diameter portion 11b, which configures the aperture 11. However, in view of FIG. 2 of Lerner, it is obvious that the joint portion is not in the central portion in the thickness direction of the mask body as recited in Applicants’ independent Claims 1 and 4.

Regarding the rejection of Claims 2 and 5 (now cancelled and incorporated into Claims 1 and 4, respectively), Applicants traverse the assertion in the Official Action⁴ that Lerner discloses a joint region located in “a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from one of the surface sides of the effective area.” Column 4, lines 36 to 38 of Lerner, referred to in the Official Action, describes only a structure of the aperture in the center of the shadow mask, where the small diameter portion 11a “usually has a maximum depth t_1 not exceeding half the thickness of the sheet from which mask 10 is constructed,” whereas column 4, lines 46 to 50 of Lerner describes a structure of the aperture in an edge portion of the shadow mask the thickness t_2 decreases with radial displacement from the center. Applicants submit that these teachings do not reach the level of detail contained in Applicants’ claimed invention.

² Specification, page 15, line 25 – page 21, line 22.

³ Lerner, Column 4, lines 36-50

⁴ Official Action, page 3, line 21 – page 4, line 11.

Furthermore, Lerner discloses a preferred embodiment where the thickness of the shadow mask 10 is $T =$ approximately 15mm; and an aperture wall $t1 =$ approximately 4mm (from the side of $d1$).⁵ Accordingly, when $T = 1$, the location of the joint portion is within the range of $4/15 =$ approximately 0.267 from the side of $d1$. This is clearly out of the range of $0.5 \pm 1/6$ of the present invention. Therefore, Applicants submit that Lerner does not disclose “in a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of at least the electron beam passage apertures in the central portion of the effective area being situated in a central portion in the thickness-direction of the mask body within a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from one surface side of the effective area, when the thickness of the mask body is represented by 1” as recited in independent Claims 1 and 4.

Regarding the rejection of Claims 3 and 6, Applicants traverse, for at least the above-identified reasons, the assertion that Lerner discloses a structure where, between the center portion of the mask and the position at $2L/3$, a joint portion of an aperture is located within the range of $0.5 \pm 1/6$, as recited in Claims 3 and 6.

Applicants have also considered the Simpson et al. reference and submit this reference does not cure the deficiencies of Lerner. Simpson et al. teaches a color display apparatus with elliptical openings 45 for apertures 43 which are offset from corresponding circular openings 44.⁶ However, Simpson et al. does not disclose a joint region located in “a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from one of the surface sides of the effective area.” Applicants therefore submit none of the cited prior art, individually or in combination, disclose or suggest all the elements of independent Claims 1 and 4. Therefore, Applicants submit the inventions defined by Claims 1 and 4, and all claims depending

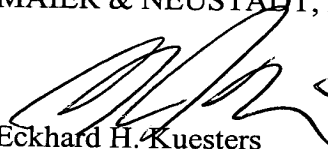
⁵ Lerner, column 6, lines 9-20.

⁶ Simpson, et al., Column 4, lines 5-15.

therefrom, are not rendered obvious by the asserted prior art for at least the reasons stated above.⁷

Accordingly, in view of the present amendment and in light of the previous discussion, Applicants respectfully submit that the present application is in condition for allowance and respectfully request an early and favorable action to that effect.

Respectfully submitted,
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⁷ MPEP § 2142 "...the prior art reference (or references when combined) must teach or suggest **all** the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)."

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IN THE CLAIMS

1. (Amended) A shadow mask comprising:

a mask body including a substantially rectangular effective area having a minor axis and a major axis extending at right angles to each other; and

a large number of electron beam passage apertures formed in the effective area,

each of the electron beam passage apertures being formed of a communication hole connecting a larger hole opening in one surface of the effective area and a smaller hole opening in the other surface of the effective area,

in a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of at least the electron beam passage apertures in the central portion of the effective area being situated in a central portion in the thickness-direction of the mask body ~~in a central portion in the thickness direction of the mask body~~
within a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from one surface side of the effective area, when the thickness of the mask body is represented by 1,

in a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of the electron beam passage apertures located on the major axis and in the peripheral portion of the effective area being situated closer to one of the surface sides of the effective area than the joint portion of each of the electron beam passages apertures in the central portion of the effective area, the larger hole being offset against the smaller hole in the direction of the major axis.

2. (Cancelled)

3. (Amended) A shadow mask according to claim 21, wherein said joint portion of each of the electron beam passage apertures in a region between the minor axis of the effective area and a position at a distance of $2L/3$ in the major-axis direction from the minor axis is situated within the range of $0.5 \pm 1/6$ in the thickness direction of the mask body, from one of the surface sides of effective area, where L is the length from the minor axis of the effective area to a major-axis-direction end thereof, and

said joint portion of each of the electron beam passage apertures in a region at the distance of $2U/3$ or more in the major-axis direction from the minor axis of the effective area is situated outside the range of $0.5 \pm 1/6$ in the thickness direction of the mask body.

4. (Amended) A color cathode ray tube comprising:

an envelope including a substantially rectangular face panel having a phosphor screen on the inner surface thereof;

a shadow mask opposed to the phosphor screen; and

an electron gun for emitting electron beams toward the phosphor screen through the shadow mask,

the shadow mask comprising a mask body including:

a substantially rectangular effective area having a minor axis and a major axis extending at right angles to each other and a large number of electron beam passage apertures formed in the effective area,

each of the electron beam passage apertures being formed of a communication hole connecting a larger hole opening in one surface of the effective area and a smaller hole opening in the other surface of the effective area,

in a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of at least the electron beam passage apertures in the central portion of the effective area being situated ~~in a central portion in the thickness~~

direction of the mask body within a range of $0.5 \pm 1/6$ in the thickness direction of the mask body from a surface side of the effective area when the thickness of the mask body is represented by 1,

in a cross section of the mask body in the major axis direction, a joint portion between the larger and smaller holes of each of the electron beam passage apertures located on the major axis and in the peripheral portion of the effective area being situated closer to one of the surface sides of the effective area than the joint portion of each of the electron beam passages apertures in the central portion of the effective area, the larger hole being offset against the smaller hole in the direction of the major axis.

5. (Cancelled)

6. (Amended) A color cathode ray tube according to claim 54, wherein said joint portion of each of the electron beam passage apertures in a region between the minor axis of the effective area and a position at a distance of $2L/3$ in the major-axis direction from the minor axis is situated within the range of $0.5 \pm 1/6$ in the thickness direction of the mask body, from one of surface sides of the effective area, where L is the length from the minor axis of the effective area to a major-axis-direction end thereof, and

said joint portion of each of the electron beam passage apertures in a region at the distance of $2L/3$ or more in the major-axis direction from the minor axis of the effective area is situated outside the range of $0.5 \pm 1/6$ in the thickness direction of the mask body.